

# Contents

Abstract .....	i
Contents .....	ii
List of Figures .....	v
List of Tables .....	viii
CHAPTER 1: Introduction .....	1
1.1 Requirements Analysis .....	1
1.2 Requirements Analysis Definitions .....	1
1.3 Requirements Analysis Objective .....	4
1.4 Requirements Analysis Benefits .....	5
1.5 Requirements Analysis Difficulties .....	6
1.6 Easing Requirements Analysis Difficulties .....	8
1.7 Groupware .....	9
1.8 Research Motivation .....	11
1.9 Research Objective .....	11
1.10 Research Importance .....	12
1.11 Research Scope .....	12
1.12 Methodology .....	13
1.13 Thesis Organization .....	15
CHAPTER 2: Review on Requirements Analysis and Groupware .....	18
2.1 Introduction .....	18
2.2 Requirements Analysis .....	18
2.2.1 Goal Based Requirements Analysis .....	18
2.2.2 Win-Win Requirements .....	25
2.2.3 Inquiry cycle .....	34
2.2.4 KJ .....	37
2.2.5 Summary of the reviewed methodologies and tools .....	40
2.3 Groupware .....	41
2.3.1 Definition of Groupware .....	42
2.3.2 Groupware Parameters .....	44
2.3.3 Groupware Taxonomy .....	46
2.3.4 Importance of Groupware .....	49
2.3.5 Groupware Design .....	50
2.3.6 Performance and Acceptance of Groupware Application .....	51
2.3.7 Groupware for Requirements Analysis .....	53
2.4 Research Framework .....	55
2.4.1 Requirements Analysis Method .....	55
2.4.2 Groupware Supported .....	59
2.4.3 Implementing a web-based tool .....	60
2.4.4 Evaluating GRAT .....	62
2.5 Summary .....	62
CHAPTER 3: Groupware Support for a Requirements Analysis Model .....	63
3.1 Introduction .....	63
3.2 GRAT Architecture .....	63
3.2.1 Domain Understanding .....	65
3.2.2 Requirements Collection .....	65

3.2.3	Classification.....	66
3.2.3.1	Categories Collection.....	66
3.2.3.2	Classification.....	67
3.2.4	Conflict Resolution.....	68
3.2.5	Prioritization.....	69
3.2.6	Requirements Validation.....	70
3.3	The Role of Project Manager.....	71
3.4	Summary.....	73
CHAPTER 4: GRAT Analysis and Design.....		74
4.1	Introduction.....	74
4.2	GRAT Analysis.....	74
4.2.1	Requirements Analysis.....	74
4.2.1.1	Functional Requirements.....	74
4.2.1.2	Non-Functional Requirements.....	80
4.2.2	Object-Oriented Analysis.....	81
4.3	GRAT Design.....	82
4.3.1	GRAT Architecture.....	82
4.3.1.1	The Presentation Layer.....	82
4.3.1.2	The Application Layer.....	82
4.3.2	Object-Oriented Design.....	82
4.4	Summary.....	83
CHAPTER 5: GRAT Implementation and Execution.....		84
5.1	Introduction.....	84
5.2	Implementation.....	84
5.2.1	Environment.....	84
5.2.1.1	Lotus Domino and Lotus Notes.....	84
5.2.1.2	Formula.....	87
5.2.1.3	Lotus Script.....	87
5.2.1.4	Internet.....	89
5.2.1.5	HyperText Markup Language (HTML).....	90
5.2.1.6	JavaScript.....	93
5.2.1.7	Java Applets.....	94
5.2.1.8	Web Browser.....	96
5.2.1.9	Windows NT.....	97
5.2.2	GRAT Phases.....	99
5.2.2.1	Project Repository.....	99
5.2.2.2	Domain Understanding.....	100
5.2.2.3	Requirements Collection.....	101
5.2.2.4	Categories Collection.....	102
5.2.2.5	Classification.....	103
5.2.2.6	Conflict Resolution.....	104
5.2.2.7	Prioritization.....	105
5.2.2.8	Requirements Validation.....	106
5.2.2.9	Change Phases.....	107
5.2.2.10	Activity Scheduling.....	108
5.2.2.11	Completion.....	109
5.3	Execution.....	109
5.4	Summary.....	111
CHAPTER 6: GRAT Evaluation and Results.....		112
6.1	Introduction.....	112
6.2	Pilot Study.....	112

6.3	Participants.....	112
6.4	Experimental Material.....	113
6.5	Measurements and Results.....	114
6.5.1	Participants Background .....	114
6.5.2	Ease of Use .....	115
6.5.3	Components Functionality .....	117
6.5.4	Achievement of Objective .....	121
6.5.5	Enhancements of GRAT .....	123
6.6	Summary .....	124
CHAPTER 7: Conclusion .....		125
	Research Summary .....	125
	Contribution .....	126
	Future Work .....	127
	Bibliography .....	129
APPENDIX A: GRAT Object-Oriented Analysis And Design.....		135
APPENDIX B: GRAT User Interface Design .....		166
APPENDIX C: GRAT Questionnaire.....		181

## List of Figures

Figure 1.1: Results of GAO survey of software contracts (Sridhar, March 1994).....	7
Figure 1.2: Methodology applied for GRAT .....	15
Figure 2.1: Example of the identified Goal (Anton, 1996).....	19
Figure 2.2: Example of a goal schema (Antón, 1996) .....	21
Figure 2.3: Project Repositories (Antón, 1996) .....	22
Figure 2.4: GBRAT Form to Create Goals (Antón, 1996) .....	23
Figure 2.5: Viewing Goals by Name (Antón, 1996).....	24
Figure 2.6; Reconciled Win-Win Spiral Model.....	27
Figure 2.7: Win-Win decision objects and relation between them .....	28
Figure 2.8: A subset of the WinWin ontology for decision rationale .....	29
Figure 2.9: An initial conceptualization of the decision structure supporting analysis of Win-Win requirements model.....	30
Figure 2.10: WinWin Scenario .....	33
Figure 2.11: File attachment utility in WinWin.....	33
Figure 2.12: Inquiry Cycle Model.....	35
Figure 2.13: Summary of KJ Method. ....	39
Figure 2.14: Results of Requirements Analysis using KJ Method. (Takeda, 1992).....	39
Figure 2.15: Groupware's position in IT architecture (Collaborative Strategies, 1996) 43	
Figure 2.16: Survey on web based groupware .....	52
Figure 2.17: Survey results on Groupware Advantages .....	52
Figure 2.18: Survey results on Groupware Disadvantages.....	53
Figure 2.19: Generic Requirements Engineering Process .....	55
Figure 2.20: Requirements Analysis Process.....	56
Figure 3.1: Requirements Analysis Process (Sommerville, 1996) .....	64
Figure 3.2: Domain Understanding in GRAT.....	65
Figure 3.3: Requirements Collection in GRAT .....	66
Figure 3.4: Categories Collection in GRAT .....	67
Figure 3.5: Classification in GRAT .....	67
Figure 3.6: Computation of Classification Results in GRAT .....	68
Figure 3.7: Conflict Resolution in GRAT.....	69
Figure 3.8: Prioritization in GRAT .....	70
Figure 3.9: Prioritization in GRAT .....	70
Figure 3.10: Requirements Validation in GRAT .....	71
Figure 5.1: Internet in a glance. ....	90
Figure 5.2 : HTML during a web page is displayed .....	92
Figure 5.3: Components of JavaScript.....	94
Figure 5.4: Web browser role in the Internet (Abstracted from Walther S.).....	96
Figure 5.5: Client computer connected to a Server.....	97
Figure 5.6: Windows NT and OSI (Abstracted from Wolters V. ).....	98
Figure 5.7: Project Repository .....	99
Figure 5.8: Domain Understanding.....	100
Figure 5.9: Requirements Collection.....	101
Figure 5.10: Project Repository.....	102
Figure 5.11: Classification.....	103
Figure 5.12: Conflict Resolution.....	104

Figure 5.13: Prioritization .....	105
Figure 5.14: Requirements Validation .....	106
Figure 5.15: Change Phase.....	107
Figure 5.16: Activity Scheduling.....	108
Figure 5.17: Project Completion.....	109
 Figure 6.1: GRAT's Ease of Use Results .....	117
Figure 6.2: Rate of the Overall facilities in GRAT .....	121
Figure 6.3: Average and standard deviation score for Question 2.....	123
 Figure A.1: GRAT Project Repository use-cases .....	135
Figure A.2: GRAT Domain Understanding use-cases.....	136
Figure A.3: GRAT Requirements Collection use-cases .....	137
Figure A.4: GRAT Categories Collection use-cases .....	138
Figure A.5: GRAT Classification use-cases .....	139
Figure A.6: GRAT Conflict Resolution use-cases.....	140
Figure A.7: GRAT Prioritizing use-cases.....	141
Figure A.8: GRAT Validation use-cases .....	142
Figure A.9: GRAT Activity Scheduling use-cases.....	143
Figure A.10: GRAT Users class diagram. ....	144
Figure A.11: GRAT system classes. ....	144
Figure A.12: Projects class diagram created on GRAT.....	145
Figure A.13: Create project class diagram.....	145
Figure A.14: Submitting documents for Domain Understanding class diagram. ....	145
Figure A.15: Submitting requirement for Requirement Collection class diagram.....	145
Figure A.16: Submitting categories for Categories Collection class diagram.....	146
Figure A.17: Classification process class diagram. ....	146
Figure A.18: Submitting conflict for Conflict Resolution class diagram. ....	146
Figure A.19: Submitting validation for Categories Collection class diagram.....	146
Figure A.20: Log in interaction diagram. ....	148
Figure A.21: Creating new project interaction diagram. ....	149
Figure A.22: Choosing team members interaction diagram. ....	150
Figure A.23: Viewing projects interaction diagram. ....	151
Figure A.24: Changing phases interaction diagram.....	152
Figure A.25: Deleting document interaction diagram. ....	153
Figure A.26: Add document in Domain understanding interaction diagram.....	154
Figure A.27: Viewing in Domain Understanding interaction diagram.....	155
Figure A.28: Submitting requirements interaction diagram. ....	156
Figure A.29: Submitting categories interaction diagram. ....	157
Figure A.30: Classification interaction diagram.....	158
Figure A.31: Computation of classification result interaction diagram.....	159
Figure A.32: Submitting conflicts interaction diagram.....	160
Figure A.33: Responding to conflicts interaction diagram. ....	161
Figure A.34: Prioritization interaction diagram.....	162
Figure A.35: Computation of prioritization interaction diagram.....	163
Figure A.36: Validation interaction diagram. ....	164
Figure A.37: Activity scheduling interaction diagram.....	165
 Figure B.1: GRAT's login prompt.....	166
Figure B.2: Viewing all active projects .....	167
Figure B.3: Creating a new project.....	167
Figure B.4: Choosing Team Members.....	168

Figure B.5: Listing of the created Project ..... 168

Figure B.6: As viewed by Project Manager ..... 169

Figure B.7: As viewed by other Team Members ..... 169

Figure B.8: List of information being shared ..... 170

Figure B.9: Submitting information or files for sharing ..... 170

Figure B.10: Requirements being collected ..... 171

Figure B.11: Edit submitted requirements by author of the requirement ..... 171

Figure B.12: List of Requirements and the Categories ..... 172

Figure B.13: Submitting Categories ..... 172

Figure B.14: Classification process ..... 173

Figure B.15: Preview before submitting ..... 173

Figure B.16: Categorized Requirements ..... 174

Figure B.17: Submit Conflicts ..... 174

Figure B.18: Conflicts updated ..... 175

Figure B.19: Respond to the conflict ..... 175

Figure B.20: Updated conflicts and responds view ..... 176

Figure B.21: Prioritizing Requirements ..... 177

Figure B.22: Preview before submitting ..... 177

Figure B.23: Prioritized Requirements ..... 178

Figure B.24: Requirements validation form ..... 178

Figure B.25: Update validation information ..... 179

Figure B.26: Submitting schedule activity ..... 180

Figure B.27: Schedule updated into main project web page ..... 180

## List of Tables

Table 1.1: Possible causes of system failure (Lyytinen, 1987).....	8
Table 2.1: Comparison of the reviewed tools .....	40
Table 2.2: Advantage and disadvantage of the reviewed tools.....	41
Table 2.3: Scenario for Software of Yesterday, Today and Tomorrow.....	44
Table 2.4: Time and Place Dimensions of Groupware Examples. ....	46
Table 2.5: How mindsets influence group design.....	50
Table 2.6: Comparison of the requirements analysis too against the groupware support .....	54
Table 2.7: Comparison of Ian Sommerville's methodology based on the advantage of the GBRAM, Win-Win, Inquiry Cycle and KJ.....	58
Table 2.8: Comparison of the groupware features of GRAT against other tools .....	59
Table 2.9: Comparison of GRAT against other tools based on the requirements analysis methods and supported architecture.....	61
Table 3.1: Phases in Requirements Analysis. ....	64
Table 6.1: Summary of participants' background.....	114
Table 6.2: Summary of GRAT's Ease of Use.....	116
Table 6.3: Summary of GRAT's components functionality.....	118
Table 6.4: Summary of GRAT's achievement of objectives.....	122